Grade: 6th – Adult
Time: 1 hour
Season: spring, summer, fall

WATER QUALITY

National Science Teaching Standards

A. Science as **INQUIRY**
B. PHYSICAL Science
C. LIFE Science
D. EARTH Science
E. Science **TECHNOLOGY**
F. Science in **PERSONAL** and **SOCIAL PERSPECTIVE**

Background Information:

The quality of a body of water can be affected by human or animal activity either within that body of water or within its watershed. The watershed consists of all of the land that drains into a particular body of water. Watershed runoff increases the amount of sediment and levels of nutrients, such as nitrogen and phosphate in the water. Sediment contributes to the turbidity, or cloudiness of the water. The chemical make-up, pH, dissolved oxygen content and even temperature can be good indicators of water quality.

In order to assess the water quality of a particular pond, stream, or lake, we will be conducting tests to determine the levels of dissolved oxygen, nitrate, and phosphate, in the water as well as the pH, temperature, and turbidity level.

Pre Activity:

- Discuss key words: watershed, turbidity, ph, dissolved oxygen.
- Go over background information with students.
- Practice reading thermometers in different water temperatures.

Objective:

Students will make chemical and physical assessments to determine the water quality of a local body of water. They will consider and discuss their results in relation to factors affecting the body of water and its surrounding watershed.

Equipment:

- Water Quality Test Kit (1 per group of 3-5 students):
  - Dissolved Oxygen Test Kit
  - Phosphate Test Kit
  - Nitrate Test Strips
  - pH Test Strips
  - Thermometer
  - Jackson Turbidity Tube
- Clipboards (1 per group of students)

- Water Quality Assessment Sheets
- Pencils (1 per group of students)

Procedure:

1. Set out equipment.
2. Lead group to study site, (pond, lake, or stream,) bringing equipment. Divide students into groups, with 3 -5 per group.
3. Ask the students what they expect the level of water quality to be based on initial observations. They will later discuss how actual test results support or disprove their initial perceptions. Groups are now ready to perform the testing.
4. Demonstrate each test for the entire group prior to the smaller groups conducting their own tests.
5. Each group should designate one member with a watch as the timer for those tests in which timing is a factor.
6. Each group should select one location on the body of water, and perform all tests at that spot.
7. Results should be recorded by one member of each group as tests are performed.

TEST #1:

Temperature: Measure the temperature of the water by suspending a thermometer attached to a cord about 4 inches below the surface. Keep the thermometer in the water for at least 2 minutes before taking a reading.

TEST #2:

Turbidity: Collect a water sample from your site, filling the Jackson turbidity tube to the top. Place the tube upright on a flat surface. While looking directly into the top of the tube, release water slowly, using the small hose at its base. Continue to release water until the black and white secchi pattern is visible at the bottom of the tube. Record the reading on the tube that is closest to the water line.

TEST #3:

pH: Be prepared to time this test. Dip a pH test strip into the water and remove immediately. Do not shake excess water from the test strip. Hold the strip level for **15 seconds.** Compare the pH test pad to the color chart on the bottle. Estimate results if the color on the test pad falls between two colors.

TEST#4:

Dissolved Oxygen: Be prepared to time this test. Using the sample cup in the test kit, collect a 25 ml sample of water from below the surface. Place an ampoule into the sample cup and press it against the side of the cup to snap off the tip. Allow the ampoule to fill with water from the sample, then remove it. Mix the contents by inverting the ampoule several times. Wait for **2 minutes** as the color develops. Compare the color of the sample to the control in the test kit to determine the level of dissolved oxygen. If the color is between to colors in the test kit, an estimation should be made.

TEST #5:

Nitrate/Nitrite: (Nitrate is a form of nitrogen that is easily dissolved and more commonly found in bodies of water than nitrite. Nitrite is quickly converted to nitrate or escapes to the atmosphere as nitrogen gas.) Be prepared to time this test. Dip a Nitrate/Nitrite test strip into the water for one second and remove. Hold the test strip level for **30 seconds.** Compare the inner test pad to the nitrite-nitrogen color chart on the bottle. Estimate the value if the color falls between 2 colors on the chart.
Wait another **30 seconds**, (for a total of 60 seconds), for the nitrate test. Compare the outer test pad to the nitrate-nitrogen color chart on the bottle. Estimation should be used if the color is between 2 colors on the chart.

TEST #6:

Phosphate: Be prepared to time this test. Fill the sample cup in the test kit to the 25 ml mark. Add 2 drops of A-8500 Activator Solution. Place the cap on the sample bottle and shake to mix the contents. Place an ampoule in the sample cup and press it against the side of the cup to snap off the tip. Allow the ampoule to fill with water from the sample. Invert several times to mix. Wait **2 minutes** for the color to develop. Compare the color of the test ampoule to the color comparator to determine the level of phosphate. Estimate a concentration if the sample is between 2 colors on the standard.

If time allows, groups may want to perform water quality testing on both a pond or lake **and** a stream, to compare and contrast results.

Background Information for Tests:

Temperature:

The temperature of the water directly affects the organisms it supports. Metabolic rates of aquatic organisms increase as water temperatures increase, as does photosynthesis of algae and aquatic plants. Oxygen levels decrease in warmer water. The sensitivity of organisms to pollution, parasites, and disease increases in warmer water. Water temperatures are lower in areas with riparian buffers, which add shade and also decrease erosion and slow runoff. Optimal temperatures for aquatic life range from 41 - 77 degrees Fahrenheit (5 – 25 degrees Celsius.)

Dissolved Oxygen:

Dissolved oxygen is the amount of oxygen dissolved in the water and available to aquatic organisms, measured in parts per million. (A result of 5 parts per million means that of 1,000,000 parts in a sample, 5 of them are dissolved oxygen.) Oxygen is added to water through its movement over rocks or dams, or through waves or currents, through precipitation, and through photosynthesis of aquatic plants and algae. Dissolved oxygen is affected by:

Temperature:	Colder water holds more dissolved oxygen.
Flow of water:	More movement means more dissolved oxygen
Time of day:	Levels increase from morning to late afternoon due to photosynthesis. Levels decrease throughout the evening.
Decomposition:	Decomposition of plants and animals uses up oxygen.
Runoff:	Runoff entering the water decreases dissolved oxygen.

A minimum level of 5 PPM of dissolved oxygen is required for warm-water animals to live.

PH:

pH is a measure of the hydrogen ion (H+) concentration, and will have a value of 0 – 14. A solution with a pH greater than 7 is basic, one less than 7 is acidic, and equal to 7 is neutral. pH depends greatly on the dissolved materials that are in the water. A pH ranging from 6.5 -8.2 is considered optimal for most life.

Turbidity:

Turbidity measures the relative amount of sediment suspended in a water sample. We will use a Jackson turbidity tube to determine the highest water at which a pattern on the bottom of the tube remains visible.

Nitrogen/Phosphates:

While the presence of nitrogen and phosphorus is necessary for growth and reproduction of aquatic organisms, excessive amounts may be detrimental. Overgrowth of plants and animals in response to high nutrient levels can obstruct waterways, increase shade, and decrease levels of dissolved oxygen as vegetation decomposes. Elevated nitrogen and phosphate levels may result from runoff from fields, lawns, feedlots, and sewage treatment plants, as well as other sources. Nitrogen levels of 0.1 – 0.3 PPM are considered clean, natural waters. 1 PPM may contribute to dense algae growth in ponds. Drinking water sources with levels of 45 PPM have been found to be hazardous for infants to drink. The national drinking water standard is 10 mg/l, even though polluted waters often have a nitrate-nitrogen level of less than 1 mg/l. Even very small amounts of phosphorous (.01mg/l) may lead to significant plant and algal overgrowth.

Post Activity:

- Contact Des Moines Water Works – invite a speaker to discuss how we can help be responsible water citizens.
- Contact Iowater (site online will have phone #) – have them come out and help test water you have collected from different sites: tap water from home and school, nearby creek water, Raccoon River and Des Moines River, Saylorville Reservoir. Test for the same tests you tested at Springbrook. Ask how the class can become part of Iowater's testing program.

Post Discussion:

- Discuss results from Springbrook water testing.
- Discuss pollutants of Iowa waters: soil (biggest pollutant), farming practices and chemicals, runoff and erosion, pet and animal droppings, oil from vehicles, air pollution and water cycle add pollutants to water.
- What else might be in the water? (what kind of bacteria)
- What responsibility do we have as citizens and scientists of the EARTH to protect our waters?
- What can you do specifically to help Iowa's waters?
- Make a plan…most importantly, carry it out…forever!